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| EXAMINER | |
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| DANIELS, MATTHEW J | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/555,287 | AZAMI ET AL. | |
| | Examiner | Art Unit | |
| | MATTHEW J. DANIELS | 1791 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *23 October 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,2 and 4-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2 and 4-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. **Claims 1, 2, 4-7, and 10-18** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kasuya (J. Phys. Chem. B, Vol. 106, No. 19 (2002), pp. 4947-4951) in view of Iijima (Chemical Physics Letters, Vol. 309 (1999) pp. 165-170). **As to Claim 1**, Kasuya teaches a method of producing a carbon nanohorn assembly comprising:

irradiating a surface of a graphite target (paragraph bridging 4947-4948) with pulse light (*Id.*) to vaporize carbon vapor from said graphite target (*Id.*) and recovering the carbon vapor to obtain a carbon nanohorn (Figs. 2-3),

wherein a power density of said pulse light is set in a range of 5 $kW/cm^2$ or more and 25 $kW/cm^2$ or less (paragraph bridging 4947-4948), and

wherein a pulse width of said pulse light is set in a range of 0.5 seconds (paragraph bridging 4947-4948), fulfilling the claimed pulse conditions when the total cycle is 1 Hz (1 cycle/second and 500 ms laser pulse teach that Kasuya provided a 500 ms pause).

Kasuya is silent to the step wherein an irradiation position of said pulse light is moved at substantially constant speed when the surface of said graphite target is irradiated with said pulse light.

However, at the time of the invention it was a known technique to provide a rotating carbon rod. For example, Iijima teaches a rotating rod (page 166), and it would have been obvious to rotate at a constant speed.

It would have been prima facie obvious to one of ordinary skill in the art at the time of the invention to incorporate the method of Iijima into that of Kasuya because Kasuya expressly suggests it in pointing to endnote three as providing the experimental apparatus and technique. See the paragraph bridging pages 4947 and 4948 and endnote three of Kasuya.

**As to Claim 2**, Kasuya teaches 1 Hz (paragraph bridging 4947-4948), or 1 cycle per second, which would leave a pause width of 500 ms. **As to Claims 4, 15, and 16**, the target of Iijima is 30 mm in diameter and travels at 6 RPM (Iijima, page 166, left column). The circumference of the target of Iijima is therefore (30/2) * 2 * 3.14 = 94.2 mm. Since the rate of rotation is 6 RPM, the surface of the target travels a total of 565.2 mm/minute, or 9.42 mm/sec. This is within the claimed range of Claims 4 and 15, and substantially the same as that claimed in Claim 16. Additionally, it is submitted that that rotation is a variable that one would have optimized through routine experimentation. **As to Claims 5-7**, in the Iijima process, the graphite target is rotated about a central axis and the irradiation position is moved by axial advancement along its axis such that the angle would stay constant, but irradiation positions would not overlap due to the axial advancement (page 166, left column, first full paragraph). **As to Claims 10 and 11**, since Kasuya teaches 150 to 760 Torr of argon gas (page 4947, right column), and since 1 Torr = 133.3 Pa, Kasuya teaches an argon or helium pressure of $2*10^4$ to $10^5$ Pa, overlapping the claimed range. **As to Claim 12**, Kasuya teaches that the chamber was evacuated prior to introduction of the buffer gas, suggesting that the vacuum was within the claimed range.

Additionally, Applicants are in the best position to identify what the actual gas pressure was in the Kasuya process. **As to Claim 13**, Iijima teaches that it is known to provide pulse durations that last from 10 ms to continuous illumination, and selection of a pulse duration within the claimed range would have been obvious through routine experimentation. **As to Claim 14**, it is submitted that Iijima and Kasuya appear to have used the same laser ablation system, and where Kasuya provides a different power density, it is submitted that Kasuya would have obviously provided a smaller spot size than the 10 mm used by Iijima (Iijima, page 165, right column). Additionally, power density a result effective variable which would result in greater amounts of ablation or different heating rates or temperatures in the ablated region. Therefore, because one of ordinary skill in the art would have recognized that power density may be varied to produce a range of ablation conditions, and adjustment of the power density would have led to larger or smaller spot sizes, one would have arrived at the claimed spot sizes through routine optimization of the power density. **As to Claims 17 and 18**, in the Iijima process, the target is a graphite rod and travels at 6 RPM (Iijima, page 166, left column).

2. **Claims 8, 9, and 14** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kasuya (J. Phys. Chem. B, Vol. 106, No. 19 (2002), pp. 4947-4951) in view of Iijima (Chemical Physics Letters, Vol. 309 (1999) pp. 165-170), and further in view of Perry (US 6,372,103). Kasuya and Iijima teach the subject matter of Claim 1 above under 35 USC 103(a). **As to Claims 8 and 9**, Kasuya teaches a graphite target rod (page 4947, right column) and irradiation with laser (page 4947, left column), but is silent to the irradiation angle. However, Perry teaches that in using a rotating graphite rod (3:18-19), it is conventional to use a beam impinging on the

rod at 45 degrees (3:19-21). It would have been prima facie obvious to one of ordinary skill in the art at the time of the invention to incorporate the impingement angle of Perry into the Kasuya process because (a) the Perry process is a comparable process to the Kasuya reference and one of ordinary skill in the art would have found it obvious to apply the Perry improvement to the Kasuya process in order to provide the ability to direct the resulting plume in a desired direction (3:10-33). **As to Claim 14**, it is submitted that spot size represents a result effective variable that the ordinary artisan would have obviously modified in order to produce different fluence levels or power densities. it is submitted that Iijima and Kasuya appear to have used the same laser ablation system, and where Kasuya provides a different power density, it is submitted that Kasuya would have obviously provided a smaller spot size than the 10 mm used by Iijima (Iijima, page 165, right column). Additionally, power density a result effective variable which would result in greater amounts of ablation or different heating rates or temperatures in the ablated region. Therefore, because one of ordinary skill in the art would have recognized that power density may be varied to produce a range of ablation conditions, and adjustment of the power density would have led to larger or smaller spot sizes, one would have arrived at the claimed spot sizes through routine optimization of the power density. Additionally, Perry teaches that it is known to use spot sizes of up to 600 microns (0.6 mm) in laser ablation systems. It would have been prima facie obvious to one of ordinary skill in the art at the time of the invention to incorporate the spot size of Perry into the Kasuya process because one attempting to achieve laser ablation in the Kasuya process would have selected spot sizes from among those which are conventional in the art, and to thereby apply the improvement of Perry to the Kasuya process.

3. **Claims 19, 20, and 21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kasuya (J. Phys. Chem. B, Vol. 106, No. 19 (2002), pp. 4947-4951) in view of Iijima (Chemical Physics Letters, Vol. 309 (1999) pp. 165-170), and Perry (US 6,372,103). **As to Claim 19**, Kasuya teaches a method of producing a carbon nanohorn assembly comprising:

irradiating a surface of a graphite target (paragraph bridging 4947-4948) with pulse light (*Id.*) to vaporize carbon vapor from said graphite target (*Id.*) and recovering the carbon vapor to obtain a carbon nanohorn (Figs. 2-3),

wherein a power density of said pulse light is set in a range of 5 $kW/cm^2$ or more and 25 $kW/cm^2$ or less (paragraph bridging 4947-4948), and

Kasuya is silent to (a) the step wherein an irradiation position of said pulse light is moved at substantially constant speed when the surface of said graphite target is irradiated with said pulse light, (b) the pulse width being set for 0.75 to 1.25 seconds, and (c) the irradiation angle of 30 to 60 degrees.

However, these aspects of the invention would have been obvious at the time of the invention for the following reasons:

(a) Iijima teaches a rotating rod (page 166), and it would have been obvious to rotate at a constant speed.

(b) Kasuya suggests 0.5 second pulses which is not significantly different from the claimed range. Additionally, Iijima teaches that the pulse duration can be varied from 10 ms to continuous. One having knowledge of the two processes and optimizing the pulse duration in an

effort to produce the maximum amount of carbon nanohorns would have obviously arrived at the claimed pulse durations through routine optimization.

(c) Kasuya teaches a graphite target rod (page 4947, right column) and irradiation with laser (page 4947, left column), but is silent to the irradiation angle. However, Perry teaches that in using a rotating graphite rod (3:18-19), it is conventional to use a beam impinging on the rod at 45 degrees (3:19-21). The benefit of the Perry process is that using the disclosed angle allows the resultant plume to be directed in a particular direction.

It would have been prima facie obvious to one of ordinary skill in the art at the time of the invention to incorporate the processes of Iijim and Perry into that of Kasuya because:

(a,b) It would have been prima facie obvious to one of ordinary skill in the art at the time of the invention to incorporate the method of Iijima into that of Kasuya because Kasuya expressly suggests it in pointing to endnote three as providing the experimental apparatus and technique. See the paragraph bridging pages 4947 and 4948 and endnote three of Kasuya.

(c) The improvement provided by the Perry process is the ability to direct the ablated plume in a particular direction by adjusting the angle of the laser with the target. One would have found it obvious to provide the same improvement to the Kasuya process in order to direct the ablated material toward a collector, and therefore to provide the same improvement to Kasuya. Note that Kasuya suggests a collection process on page 4948.

It would have been prima facie obvious to one of ordinary skill in the art at the time of the invention to incorporate the method of Iijima into that of Kasuya because Kasuya expressly suggests it in pointing to endnote three as providing the experimental apparatus and technique. See the paragraph bridging pages 4947 and 4948 and endnote three of Kasuya.

**As to Claim 20**, Kasuya and Iijima both suggest a process in which the pause is the same as the pulse (Iijima, page 169, left column). One using a longer pulse duration (consistent with the Iijima suggestion to vary the pulse duration from 10 ms to continuous exposure) would have found it obvious to maintain the same ratio of pause duration to pulse duration. Additionally, it is submitted that the pulse and pause duration represent result-effective variables that the ordinary artisan would optimize in order to maximize the amount of nanohorns produced. **As to Claim 21**, Perry teaches a pulse aimed at the target at a 45 degree angle (3:10-30) for the purpose of directing the plume toward a collector.

***Response to Arguments***

4. Applicant's arguments filed 23 October 2008 have been fully considered but they are not persuasive. The arguments appear to be on the following grounds:

a) Kasuya fails to disclose a pulse width and pause width fulfilling the claimed conditions.

b) Iijima discloses a rotating graphite rod at 6 rpm, and thus fails to remedy the deficiencies of Kasuya.

c) The Office Action asserts that Kasuya provides specific conditions which full the claimed ratio. However, extrapolating a mathematical relationship from raw data has been found to be impermissible. See Harries v. Air King Products Co. Even if the values set forth in Kasuya satisfy the ratio of claim 1, the mere existence of these values is insufficient.

d) New claims 8-21 are presented, which Applicant submit to be instantly patentable over the cited art.

5. These arguments are not persuasive for the following reasons:

a,b) It is respectfully submitted that this argument is factually incorrect to the extent that it asserts that Kasuya and Iijima do not provide any particular pulse length or pause length. In Kasuya (page 4948), the cycle time is one second (1 Hz) for the combined time of the pulse and the pause, and in providing a 500 ms pulse width, it is submitted that a 500 ms pause length is inherent. This result is obtained by simple subtraction of the pulse time from the cycle time. Division leads to a value fulfilling the claimed pulse/pause conditions. Iijima does not contradict these teachings from Kasuya. See page 168 of the Iijima reference, where the 0.5 s pulse ("on") and 0.5 s pause ("off") is stated explicitly in the paragraph bridging the two columns.

c) The argument and citation to case law are not persuasive for at least the reasons that (1) the case is not similar to the circumstances of this case which are a calculation, rather than an extrapolation or interpolation, (2) the case was decided prior to the 1952 Patent Act, and it is unclear that the case cited retains its vitality in view of this important statutory change, and (3) the cited case is no longer believed to reflect the Federal Circuit's or the Supreme Court's holdings regarding obviousness of ranges.

Applicants may wish to reconsider MPEP 2131.03 for recent decisions discussing anticipation of ranges and MPEP 2144.05 for more recent decisions discussing the obviousness of ranges. Even if Applicants' arguments were correct in characterizing the pulse and pause lengths in Kasuya and Iijima, no unexpected or different result is argued to distinguish the claimed invention from the two cited references.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. DANIELS whose telephone number is (571)272-2450. The examiner can normally be reached on Monday - Friday, 8:00 am - 4:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christina Johnson can be reached on (571) 272-1176. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew J. Daniels/
Primary Examiner, Art Unit 1791
1/4/08